MAGNETIC STIRRER

RELATED APPLICATIONS

This application is a non-provisional application of U.S. Ser. No. 60/807,452, filed Jul. 14, 2007.

FIELD OF THE INVENTION

The present invention relates generally to stirrers, and more particularly to a magnetic stirrer for mixing material within a vessel.

BACKGROUND OF THE INVENTION

Many chemical reactions and physical reactions (e. g., distillations) are facilitated by stirring/mixing the materials within a vessel. One way to do this is to stir the materials in a vessel with a mechanical stirrer. For example, a motor-driven rotatable spindle may be used in which one or more stirring members (e.g., blades) of the spindle can be positioned in the vessel to stir the materials.

As another example, a motor-driven magnetic stirrer may be used. In this stirrer, a magnetic stir bar is positioned within the vessel and a base magnet magnetically coupled to the stir bar is positioned under the vessel near the stir bar. A motor is used to rotate the base magnet, which in turn rotates the stir bar in the vessel to stir the materials. A magnetic stirrer is often desirable because minimal stirring structure is introduced into the vessel, reducing concerns of contamination or leakage to/from the vessel. In addition, small stir bars can be used which are easier to insert into vessels having small inlet openings such as round-bottom flasks (small inlet openings help prevent release of undesirable materials into the environment or vice versa).

However, strong base magnets are required with these magnetic stirrers, particularly when driving the stir bars in viscous materials or large volumes of materials (e.g., 20, 50 or 70 liters of materials). Traditional base magnets are often not strong enough to handle these conditions. In many cases, the coupling force between a traditional base magnet and the stir bar fails, resulting in the stir bar decoupling from the base magnet.

In addition, it is often desirable to conduct chemical reactions and/or physical reactions (e.g., distillations) under abnormal conditions, for example, under high vacuums or with highly volatile chemicals. These conditions can be adversely impacted by the components/design of the stirrer. For example, stirrer designs that have multiple joints or must be sealed would not function well in high vacuums. Similarly, electric motors would not be desirable where highly volatile chemicals are being used (e.g., where flammable or explosive materials are used).

Accordingly, it would be desirable to provide a motor-driven magnetic stirrer that can be used in high vacuum systems with highly volatile chemicals and that has a base magnet strong enough to handle highly viscous and large volumes of materials.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a perspective of a first embodiment of a magnetic stirring system of the invention;

FIG. **2** is an elevation thereof illustrating a magnetic stirring apparatus mounted under a stir-mantle;

FIG. **3** is a perspective of the magnetic stirring system with part of a stir-mantle broken away to show components of the magnetic stirring apparatus;

FIG. **4** is the view of FIG. **3** rotated one-hundred eighty degrees;

FIG. **5** is a perspective of the magnetic stirring apparatus;

FIG. **6** is the view of FIG. **5** with part of the apparatus broken away to show internal components;

FIG. **7** is a side elevation of the magnetic stirring apparatus;

FIG. **8** is a top plan view of the magnetic stirring apparatus shown in relation to a shroud of the stir-mantle where the shroud is illustrated by broken lines;

FIG. **9** is a perspective of a magnet of the magnetic stirring apparatus; and

FIG. **10** is a perspective of another embodiment of the magnetic stirring system with part of a stir mantle broken away to show components of the magnetic stirring apparatus.

Corresponding reference characters represent corresponding parts throughout the views of the drawings.

DETAILED DESCRIPTION

Referring now to the drawings, and particularly to FIGS. **1-4**, a magnetic stirring system of the invention is shown generally at **1**. The magnetic stirring system **1** generally includes a flask **3** (broadly, a "vessel"), a stir-mantle **5** shaped to support the flask within the stir-mantle, and a magnetic stirring apparatus **7** mounted to an underside of the stir mantle **5**. These components are indicated generally by their reference numbers. The illustrated flask **3** is generally spherical in shape and includes a small inlet opening **9** toward its top for introducing materials (not shown, but which may include, for example, materials used in a distillation process, highly volatile materials, explosive materials, or other materials that may ignite around sparks) into the flask **3** and for substantially preventing release of materials from the flask into the environment or vice versa. Additional openings may be present in the flask **3** to attach other components not described herein that may be used in chemical reaction and/or physical reaction (e.g., distillation) operations. The flask **3** may be made of glass or other materials capable of supporting chemical reactions and/or physical reactions (e.g., distillations) within the flask **3**. It may also range in size as required for the particular application, for example the flask **3** may be about a 20-liter flask, or the flask **3** may be about a 70-liter flask. The flask **3** may be larger or smaller within the scope of the invention. While a spherical flask is illustrated it is not limiting; a flask having a different shape (e.g., an Erlenmeyer flask) may be used. Moreover, a vessel other than a flask (e.g., a beaker) may be used within the scope of the invention.

The illustrated stir-mantle **5** includes a recess **11** in its top for receiving the lower portion of the flask **3**, and three feet (each designated **13**) at its bottom (only two feet are visible in FIGS. **1** and **2**) for supporting the stir-mantle **5**. While the illustrated stir-mantle **5** directly receives the flask **3**, a stir-mantle may be used in which the flask is supported above the stir mantle by, for example, a support frame. In addition, a stir-mantle used with a flask or other vessel within a larger tub for safety reasons or for controlling parameters of the reactions is within the scope of the invention. Heating elements **15** (FIGS. **3** and **4**) may be included within the stir-mantle **5** for providing heat to the flask **3** to facilitate chemical reactions and/or physical reactions (e.g., distillations). A stir-mantle without heating elements or with heating elements differently oriented, or a stir-mantle differently shaped is within the scope of the invention. A stir-mantle with cooling elements is also contemplated within the scope of the invention. Stir-